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This paper draws on and applies ideas from our earlier paper *On the Evolution of Credibility and Flexible Target Zones* that was presented, amongst other places, at the conference on *European Currency Crises and After*, LARE, University Bordeaux I, July 1994.

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Abstract

In this paper we consider the issues of the nature of the initial commitment to an exchange rate target zone and how to construct an incentive compatible or sustainable band for exchange rates that depends endogenously on the evolution of credibility in the system. The critical issue regarding sustainability rests on how the policy maker reacts to the continuous trade-off he faces between flexibility and credibility and hence in the market's belief as to the policy maker's commitment and ability to maintain the announced target zone. We apply the notion of relative credibility developed in Avesani, Gallo and Salmon [1994] and Svensson's "simplest measure" of target zone credibility [1991] to the experience of the French Franc in the period up to the crisis of July/August 1993 and compare these measures with newspaper accounts of perceived credibility over the same period.

Key Words: Exchange Rate Target Zones, Credibility, Flexibility, Commitment.

1 Introduction

Some ten years ago John Williamson [1983,1985] proposed a system of target zones for the world's major currencies that differs in fundamental respects from that established in the Exchange Rate Mechanism (ERM) of the European Monetary System[1]. The effective collapse of the ERM between September 1992 and August 1993 has raised obvious questions regarding the objectives it was designed to serve and hence how the system could be reformed. It has also raised questions as to the viability of target zone systems in general but in this respect the recent experience within the ERM must surely have had the positive impact of emphasising the critical role of policy coordination (as consistently argued for by Williamson) alongside the constraint imposed by the target zone on exchange rates. It can also be argued that the lack of flexibility that demonstrably led to the eventual collapse of the ERM arose, somewhat paradoxically, because its original objectives of providing a zone of financial stability had become inconsistent with and subjugated to the movement towards European Monetary Union. The ERM became in effect, not a mechanism for stabilising exchange rates but more a surrogate and indirect device for enforcing convergence in those economies that would seek to join a European Monetary Union. Little or no evidence seems to exist that explicit coordination of policies took place external to the ERM.

Williamson's original target zone proposal differs from that established in the ERM in two essential respects;

(i) The central parity in Williamson's proposal would coincide with the " fundamental equilibrium exchange rate" (FEER) which would be expected to move over time rather than some target parity that in the event remained *fixed* until a crisis forced a realignment. The FEER was defined in *real* terms and it was envisaged that relatively frequent and small realignments would be necessary to accommodate movements in the fundamentals.

(ii) The bands of the zone, "the soft buffers", would be wide enough apart to achieve a desired degree of stabilisation with a relatively weak commitment towards a "*partial direction of monetary policy to discourage the exchange rate from straying outside its target zone*".

[1]see also Williamson and Miller[1987].

In contrast, the ERM was based on relatively narrow band-widths for *nominal* exchange rates together with the strict obligation to intervene to prevent movement outside the band. The interventions were supposed to be mandatory and bilateral at the margin and discretionary intramarginally. The relative fixity of the nominal target or central parity, the narrow bands and the requirement to intervene ensured that the ERM became an inflexible and rigid tool for stabilising exchange rates in the face of real shocks let alone for achieving convergence. Williamson's proposal, on the other hand, would seem to have explicitly recognised the need for flexibility to accommodate the evolution of the credibility in the system and effects of adjusting to temporary asymmetric shocks. (see Williamson [1985] and Williamson and Miller [1987]).

This contrast between Williamson's notion of a Target Zone and that implemented in the ERM was highlighted in *The Economist* after the ERM came under pressure following the September 1992 crisis when the Lira and the Pound dropped out of the system. For instance, an article in the May 8th 1993 issue suggested, some three months before the 1993 crisis, that although the experience during 1992 was due to exceptional circumstances (the German unification process), it showed that deep changes in the way the ERM operated were required. In particular the need for more flexibility was stressed together with the need for wider bands, soft buffers at the edges in order to allow for temporary excursions from the band and the adoption of a policy of frequent realignments in order to compensate for inflation differentials; this last aspect being tantamount to establishing a band for the real exchange rate.

A reply to this article came some weeks later (on June 5th) with a letter by Barry Eichengreen and Charles Wyplosz criticising the feasibility of the "Williamson-*Economist*" proposal and suggesting the need to regulate forex markets by adopting a version of the Tobin's taxes or "sand in the wheels" proposal (Tobin [1978]) that financial institutions taking open positions in the forex should be required to keep non interest bearing deposits with Central Banks. Eichengreen and Wyplosz stressed that this suggestion would not prevent a crisis from taking place but would simply buy the time necessary for the Central Bank to engineer an orderly realignment. They also argue that the proposal for a more flexible system would undermine credibility suggesting that "nobody will believe that governments are likely to intervene when exchange rates move toward the edge of their bands".

In a companion paper, Avesani, Gallo and Salmon [1994] (AGS), we have developed a model of a *flexible* target zone which captures much of the spirit of Williamson's original notion. Moreover rather than acting somewhat passively

in the face of an attack, as Eichengreen-Wyplosz suggest, the monetary authority acts strategically, potentially well in advance of the attack and although it may, in time, realign it will do so as part of an *optimal* strategy given that it has monitored its credibility and recognises that the existing band widths are no longer sustainable. Credibility will not necessarily be lost in practice by being flexible, in this sense, but it *will* be lost by attempting to defend an unsustainable band. We show in that paper that substantial exchange rate stabilisation may in fact be achieved by adopting a target zone management strategy that explicitly reflects credibility contrary to the point of view put forward by Barry Eichengreen and Charles Wyplosz. It is important to note that this is achieved by a clear commitment to consistently and continuously defend the announced band but the commitment also recognises the importance of credibility and the need to maintain a required degree of credibility. Since credibility is not completely lost if the exchange rate passes over the band limit and if the authorities can be seen to be active in maintaining the band then credibility may well be recovered and a realignment avoided. In this sense the AGS model provides a relatively weak commitment to defend the band limits themselves and this is similar to the form of commitment suggested by Williamson and quoted above and quite unlike the rigid and inflexible commitment imposed on the ERM. The central issues lie in the *endogenous* evolution of partial credibility in the target zone and how the policy maker responds as his commitment is tested and how he trades off the desire for flexibility against a potential loss in credibility. The model essentially develops a target zone strategy that rests on a commitment to a feedback rule rather than the open loop precommitment that has been implemented in the ERM and in the Bretton Woods System. The dependence on such open loop strategies both in practice and theory would seem to have rested on the misplaced belief that only such policies would be credible and stabilise exchange rates. Notice that this does not mean that capital controls of the form suggested by Eichengreen and Wyplosz should not also be implemented as part of the flexible feedback strategy. Indeed a mechanism to include processes that slow down the financial markets ability to respond to current events is included in the AGS model.

The dynamics of credibility necessarily involves learning and the resolution of uncertainty by the markets regarding the policymaker's commitment and ability to defend the announced band and the hence the importance for the policymaker to monitor the target zone's credibility in the day–to–day operation of intervention policy within the band. This is the question we address in this paper within the specific context of Fr.Franc/DM exchange rate in the

period leading up to the ERM crisis in 1993. In Section(2) we briefly present the flexible target zone model of Avesani, Gallo and Salmon [1994]. Section(3) discusses three measures of credibility which are then compared over the 1993 crisis period. The first is a qualitative measure based on the historical evidence collected from the views expressed in various issues of *The Economist* which we treat as reflecting informed opinion in the market; the second is the computation of the "simplest measure" of target zone credibility, suggested by Svensson [1991], which is based on forward exchange rates or rates of return and the final measure is based on the concept of relative credibility put forward by AGS. Our empirical results show that the latter measure closely shadows the press accounts, whereas the Svensson measure tends to signal losses of credibility that are not accompanied by realignments and hence its power to predict realignments is likely to be low.

2 The AGS Flexible Target Zone Model

The starting point of the standard target zone model is:

$$s(t) = k(t) + \alpha E_t\left(\frac{ds}{dt}\right) \tag{1}$$

with the fundamentals $k(t)$ following a controlled Brownian motion process, with control being exerted when the fundamentals hit either limit of the implied band imposed on them. From (1), it is clear that the policy maker can affect the determination of the exchange rate in two ways: the first is directly through the fundamentals (i.e. through unsterilised intervention), the second is by modifying the markets' expectations. The imposition of an upper and a lower limit on the fundamentals brings about the honeymoon effect and the typical S-shaped curve for the fundamentals/exchange rate mapping of the Krugman model, Krugman [1991].

This basic model suggests a rigid target zone where full credibility of the band limits is assumed *ex ante*. Extensions to include imperfect credibility (see for instance, Krugman [1991], Pesenti[1990] and Bertola and Caballero [1992]) have generally assumed a probability ϕ that the policy market will defend the zone at edge of the band and a probability $1 - \phi$ that he will not defend and that a realignment of the central parity would be needed. Thus there is always an expectation of a devaluation which depends on the *exogenously* given ϕ. It is crucial to recall that in this extension of the model interventions would

occur only at the edge of the band and hence at that limit one would get unambiguous information about the commitment of monetary authorities to defend the announced band. If intervention occurs then the fully credible path remains valid, otherwise there is an immediate attack and a jump to a free–float regime.

Historically experience within the ERM has been different: interventions occur intramarginally and credibility is not evaluated by the markets only on the basis of what happens at the edges of the band but seems to follow more complex mechanisms. The events in the ERM in the Summer and Autumn of 1992 indicate the importance of credibility in determining the sustainability of a target zone and the need for the authorities to continuously monitor their credibility. These implications seem to point to the fact that instead of delaying the moment of the crisis as in the Eichengreen and Wyplozs proposal, there is room for implementing a more farsighted and flexible management strategy in a target zone that may consciously preempt the crisis, i.e. a band which evolves around a central parity that may possibly but not necessarily be recalculated, but most importantly having the clear capability of being enlarged or restricted according to the perceived credibility of policy actions. The policymaker would remain firm in his commitment to maintain that band which is deemed to be sustainable given his degree of credibility.

The AGS model starts from the recognition that full credibility cannot be assumed but it has to be earned as the result of the explicit proof of the commitment by the policy maker to actively pursue actions *at all times* which will keep the exchange rate within the band.[2] There are essentially three additional elements that are introduced beyond the standard target zone model:

1. the strategic interaction between the policy maker and the markets and the dynamics of credibility;

2. the recognition that external shocks may warrant the temporary adoption of more flexibility than that imposed by a rigid target zone;

3. the need for learning by the financial markets about the policy maker's actions and hence credibility in an uncertain world.

The endogenization of credibility in the AGS model revolves around the distinction between absolute and relative credibility. *Absolute* credibility is related to the level of exchange rate stabilization that the policy maker wants to

[2]In this section we are only able to give a brief overview of Avesani, Gallo and Salmon [1994] and the full details can be found in that paper.

(or can) achieve through the announcement of a bandwidth around a central parity value. The initial announcement corresponds to a commitment to direct policy, both inside the band and at the margins, with the objective of keeping the exchange rate within the announced limits given the shocks hitting the system. The announcement also forms the yardstick against which the markets evaluate those policy actions. Zero absolute credibility corresponds to no target zone and hence represents a free–float regime; full absolute credibility is the tightest band manageable and we assume is enforced by some external commitment or institutional agreement.

In this framework, any exchange rate regime can be characterized by a bandwidth corresponding to a solution for the exchange rate. For a given level of the fundamentals k, the solution for the exchange rate can be characterized as as a convex combination of the institutional commitment regime, hence perfectly credible, $g_{pc}(k)$ and the free–float $g_{ff}(k)$ solution:

$$g_w(k) = w g_{pc}(k) + (1 - w) g_{ff}(k). \tag{2}$$

The higher the degree of exchange rate stabilization desired, the higher will be the weight on the institutional agreement path, and vice versa. In the presence of a need for flexibility, though, the policy maker may want to deviate from the announcement and he could do so in two ways; given a certain level of fundamentals and a desire to accomodate some domestic shock, he could choose a less stabilizing path corresponding to an implicitly wider band–width (devious behavior). The second class of actions is to behave as if the band–width in place were tighter (virtuous behavior) and in this way he may invest in his stock of credibility perhaps for later use.

Relative credibility reflects the degree of confidence the markets hold in the initially announced band or effectively the corresponding value of w when comparing the observed behavior of the exchange rate and the behavior that would be in place were the policy maker to continually adhere to the announced band. In this respect, the announced bandwidth would be fully credible (in a relative sense) if the actions of the policy maker were at each point in time *consistent* with the implications of the announced band. Deviating from the announcement in the devious direction will be recognized by the markets (although not immediately) as eventually leading to a lack of sustainability of the announced band and will be reflected in a decrease in the relative credibility, but will not necessarily be immediately punished by a run on reserves while some degree of credibility is retained. In fact, experience within the ERM is

characterised by many such instances, with large swings in the exchange rate towards the margins, corresponding to less credibility, yet not all of them forcing an immediate realignment of the central parity.

In the opposite case of virtuous behavior, the level of commitment to exchange rate stabilization is higher than the one warranted by the announced band, and hence is rewarded by an increase in the relative credibility of the band itself as the markets adjust their expectations. Again, one can think of the experience of the Italian Lira prior to the official tightening of the band at the beginning of 1991, when the exchange rate was kept in a tunnel within the official band of $\pm 6\%$ as a way to achieve credibility for the next phase.

In either case the policy maker's actions signal a deviation from the announcement, the consequences of which should be taken immediately into consideration. In the case of devious behavior a (political) cost will be incurred and if repeated it may lead to the need for a new bandwidth announcement in line with the current reputation of the policy maker. In the case of virtuous behavior a political bonus is gained which may eventually if such behaviour is repeated lead to the opportunity for the announcement of a tighter bandwidth.In AGS we endogenise this process of the evolution of relative credibility while the authorities, recognising their current level of credibility, determine their *optimal* sterilised intervention strategy by trading-off the desire for flexibility against potential losses in credibility.

The simplest expression for relative credibility is then just the ratio between the band width implied by the current observed exchange rate and that originally announced. This follows immediately from (2) as:

$$rc_t = \frac{w}{w_a} = \frac{s_t - g_{ff}(k_t)}{g_a(k_t) - g_{ff}(k_t)} = 1 - \frac{s_t - g_a(k_t)}{g_{ff}(k_t) - g_a(k_t)} \tag{3}$$

Figure 1 characterises this nonlinear function in terms of the divergence between the observed exchange rate and that expected given the announced band. We can see in particular that $rc = 1$ when $s = g_a(k)$, and $rc = 0$ for $s = g_{ff}$; a symmetric function holds for the lower part of the band.

In the absence of learning the policy maker could expect to hold full relative credibility when he adheres to the (s, k) mapping consistent with the initially announced band-width, ie. along the path A ($s = g_a(k)$) in the left hand subpanel of the Figure. Beneath this "s-mapping" he may actually increase his credibility as he would be potentially adopting a tighter sterilised intervention or monetary policy than required given his initial announcement. Such credibility

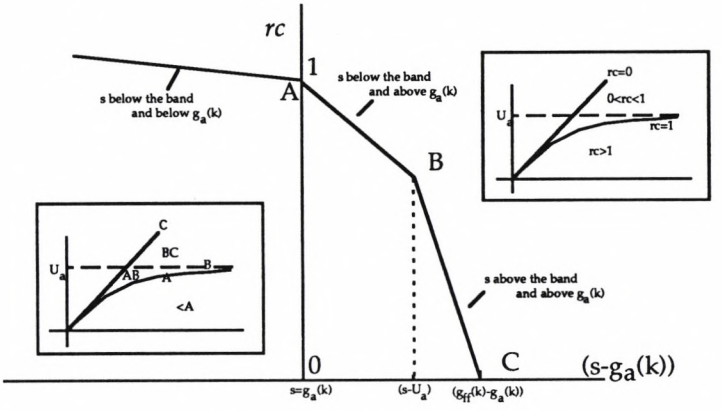

Figure 1: Relative Credibility

building is important if we wish to consider how policy can be directed towards achieving a narrower band. Above the path A, there will be a loss of relative credibility, in the region AB, which becomes more dramatic as the exchange rate passes over the upper threshold of the announced band, U_a, through B and into the region BC. The policy-maker achieves both zero relative and absolute credibility when the exchange rate coincides with the free float value.

The level of relative credibility then plays a central role in determining the exchange rate in the heterogeneous and atomistic structure assumed for the financial markets in the AGS model. This is largely as a result of the effect his credibility has on unifying the expectations of the market. Market power is initially biased towards the policy maker as a consequence of being a single large actor amongst the atomistic private agents in the market and from having greater monitoring capabilities given its institutional role. This market power however decreases with a decrease in relative credibility and is gradually shifted to the private sector to the point of being completely lost when all relative credibility is lost. This introduces a degree of asymmetric information between the policy maker and the financial markets, since the latter is uncertain about both the degree of market power held by the policy maker and his actions.

The strategic interaction between policy maker and the market then occurs as in a standard asymmetric information Stackelberg game where all players seek to maximize their objective function. The policy maker has to choose the implicit band–width he desires at each point in time which may deviate

from the announced band–width depending upon the trade-off seen between the advantages from adopting a more flexible policy stance by deviating from the announcement and incurring the resulting political costs. This is carried out in the AGS model by constructing an objective function in which, apart from non–strategic elements related to exchange rate stabilization, both the deviation of the level of the exchange rate from central parity and volatility are penalised, strategic costs are included associated with the desirability:

- to gain more flexibility than that offered by the existing band;
- of not incurring the political costs that this higher flexibility entails;
- of not being forced through a realignment to a new announcement corresponding to a lower degree of absolute credibility.

Notice that this objective function intimately involves credibility in several places and is quite distinct from the standard approach to justifying the optimality of target zones through proportional costs of intervention. The private sector or financial markets on the other hand seek to minimize their prediction errors on the level of the exchange rate and this leads to their selection of an appropriate expectations formation mechanism.

The realised exchange rate is then determined by the interaction between the policy maker and the private sector in the foreign exchange market and is critically affected by the assumed general inability of the markets to directly observe the monetary authorities' actions, as pointed out above. Interventions are assumed to be fully sterilised and not immediately observable, as often seems to be the case in practice, so that the markets face a problem of signal extraction, from observations on the observed exchange rate, to determine the monetary authorites *implicit degree of relative commitment* to the announced band. The initial fully credible (in a relative sense) announcement is subject to scrutiny by the market, in that the agents try to judge whether the observed exchange rate is consistent with the intention to defend the announced band. On his part, the policy maker takes into account the private sector's expectations and considers the trade-off between the desire for a greater monetary freedom and the political cost that devious behavior brings about. In maximizing the objective function, therefore, he chooses an intervention policy corresponding to an exchange rate determined by a solution path lying between the free float and the institutional commitment solutions and identified by a value for the parameter w between zero and one.

In updating its aggregate expectations, the private sector acknowledges that it acts in a highly nonlinear and non–constant environment in which learning should never be switched off but should be able to track the instability of the exchange rate generating mechanism. In the presence of high credibility the markets adjust rapidly to surprises in the perceived band–width, whereas low credibility in fact implies less information on policy preferences as the market power of the policy maker has been eroded. To put it differently, the policy maker has to engage in proportionally greater effort to re-establish its reputation when its relative credibility is low, than when his relative credibility is close to high.

An initial endowment of credibility is granted to the policy maker, measured by the horizontal distance from the tangency point of the S-shaped curve to a free–float regime and corresponds to the amount of fundamental adjustment or speculative attack which would bring about an immediate collapse of the announced target zone. A stagewise game is then repeated with the policy maker cumulating the political costs that result from devious and virtuous behavior. If an initial endowment of credibility is completely depleted, the announced band–width is no longer seen to be sustainable, and an enlargement of the band is needed (higher weight given to the free–float solution in (2)). The level chosen for the new announcement (new absolute credibility) is set at the bandwidth which was perceived by the markets as being that currently effective. This ensures that there are no jumps in expectations, nor in exchange rates, and hence the relative credibility function is reset to one and a new credibility endowment is available to the policy maker.

3 Alternative Measures of Credibility and the Crisis in the ERM in 1993

In this section we analyse the experience of the French Franc within the ERM from the end of October 1991 to mid-August 1993 and compare the evolution of credibility as measured by press reports to the measure of credibility proposed by Svensson (1991) and that derived from the AGS model discussed above. The behavior of the FF/DM deviations from central parity is shown in Figure 2. For future reference a band of 7.9% is superimposed to the period following August 1993.

3.1 The French Franc Behavior from Press Accounts.

One way of judging the credibility of an exchange rate band *ex post* is to reconstruct the market feelings as reported by the press, in our case *The Economist*, which is taken here to express the views of a well–informed agent.

Starting from the beginning of 1992 and stopping at the end of July 1993 (when the French Franc was forced to an enlargement of the bands to ±15%), we can isolate four main phases in the French Franc/Deutsche Mark relationship. The first lasts until the end of June 1992 with a strengthening of the Franc towards the central parity. It is interesting to note that this occurred in the presence of a stable short term interest rate differential between DM and FF denominated Eurodeposits around 50 basis points (bp) with the long term differential constantly increasing from 35-40 bp at the beginning of 1992 to 135-140 bp during the summer.

The second phase starts in July 1992 when the FF/DM weakened rapidly moving toward the upper limit of the ERM band. Short term interest rates became more volatile and the interest differential spread to more than 700 bp during the '92 crisis which forced the British Pound and the Italian Lira out of the ERM. The reason for this deterioration vis–á–vis the DM have been widely credited to the tight monetary conditions imposed by the German monetary authorities during the summer of '92. The official rates were locked until September 15 (right after the crisis) when the Bundesbank cut the discount rate by 50 bp to 8.25% and the Lombard 25 bp to 9.5%. During this period the FF/DM exchange rate fluctuated violently inside the band and the tensions were transfered to the short term rates and to an increased volatility in long term rates.

The third phase starts at the beginning of January 1993. In particular, the FF/DM exchange rate which was at the limit of maximum allowed depreciation recovered the losses (after Feb. 4 the German main intervention rates were cut by 25 bp, a move interpreted as a sign of the easing of monetary conditions), and moved rapidly toward and below the central parity, after a period of uncertainty surrounding the March elections. In the meanwhile the spreads on short and long term rates with respect to Germany also shrank to zero. Uncertainty still existed about the attitude of the new government towards monetary and fiscal issues and the reform of the Banque de France in a direction of greater independence in line with the Maastricht Treaty. The formation of the new cabinet saw the appointment of two strong supporters of European integration and of the *Franc fort* policy as Finance and European Affairs ministers. Among

the first measures adopted by the new government, the budget (May 10th – recognized as a tough one by *The Economist*) and the BdF reform plan sent a clear signal of commitment to the Maastricht Treaty and brought the short term interest rate differential in favor of the FF and the long term differential towards zero.

All these actions had the effect of dissipating the political fears that characterised the pre-election debate on the future course of French monetary policy. It seems however that while the uncertainties relating to the political will of the new French government disappeared, uncertainties hinging on the economic feasibility of the high interest rate policy seem have remained. In fact, doubts concerning the tenability of the monetary policy in face of deteriorating expectations on GDP growth and unemployment had been a constant in the press before and after the elections.

The fourth phase starts in the second half of June when the French key intervention rate was lowered by 25 bp below the German discount rate to 7% (June 21st). While the FF was strengthening towards the edge of the band[3] the Bundesbank started to ease monetary conditions on July 1st, by cutting the discount rate by 50 bp to 6.75% and the Lombard rate by 25 bp to 8.25%. At the same time BdF was not able to match the Bundesbank and cut the intervention rate by only 25 bp. The hierarchy inside the ERM was reestablished and the market was left wondering whether the Banque de France had overstreched its position.

As usual market computations and reactions are fast and not always completely understandable being a mixture of short and long term forecasts, technical evaluations and an expression of animal spririts. *Ex post* we can say that the market looked at the following issues. First of all the market was disturbed by the emphasis with which the French government was pushing the issue of the low inflation rate. At the time the French inflation rate was half that in Germany, but the reverse had been true for the previous 20 years, and thus a different anti-inflationary reputation had been established in the two countries. Secondly, the fact that France was not able to match the Bundesbank interest rates cut and restablish the differential in her favour was interpreted as a sign of weakness. It was known that France needed to follow a fast track in cutting rates since there were worsening expectations for growth and unemployment plus a growing pressure from right wing politicians to follow a more independent monetary policy and abandon the Franc fort policy.

[3]There was even some talk of the need for the DM to devalue, or for adding or substituting the FF to the DM as an anchor for the system.

Finally, in the second half of July the situation worsened very quickly: the Franc moved to the upper limit of the band and the short term interest differential reached 6%. It is by now generally acknowledged that the uncooperative behavior of the Bundesbank, which did not fulfill the expectations of further cuts before the summer recess, forced Belgium, France, Denmark, and Portugal to raise interest rates to defend their currencies. During the weekend of July 31st and August 1st, after a week of strong speculation against the French Franc counteracted only by the BdF interventions in the forex, the $\pm 15\%$ band enlargement is announced.

3.2 Svensson's "Simplest Measure of Target Zone Credibility"

Svensson (1991) starts from the consideration of uncovered interest rate parity and of the exchange rate return over τ periods:

$$R_t^\tau = \left[\left(1 + i_{t,\tau}^*\right) \frac{S_{t+\tau}}{S_t}\right] - 1 \tag{4}$$

where $i_{t,\tau}^*$ is the nominal foreign interest rate at time t for a τ maturity and S_t is the exchange rate at time t. He shows that if limits of fluctuations are imposed on the exchange rate of the kind $\underline{S} \leq S_t \leq \bar{S}$, an implicit band is imposed on the rate of return as well, $\underline{R} \leq R_t^\tau \leq \bar{R}$, defined as

$$\underline{R}_t^\tau = \left[\left(1 + i_{t,\tau}^*\right) \frac{\underline{S}}{S_t}\right] - 1, \qquad \bar{R}_t^\tau = \left[\left(1 + i_{t,\tau}^*\right) \frac{\bar{S}}{S_t}\right] - 1. \tag{5}$$

Since the tensions on the exchange rate market are passed onto the interest rate, one should see the exchange rate return move outside its implied band prior to a realignment. The reverse argument does not, however always prove to be the case. In fact in the case of the French Franc for the period under examination the evidence regarding the rate of return for the Eurodeposit one–month maturity (shown in Figure 3) shows that apart from sporadic signals in late 1991, the period around the September 1992 crisis is characterized by a breech in the upper limit which lasted almost two months. While it was clear that the French Franc was under attack, the crisis did *not* lead to a realignment. Similarly the five–month period marked by an exchange rate return above the upper limit in late 1992 and early 1993, as we have seen from the press accounts, was actually marked by fluctuating periods in which the French Franc gained and lost credibility without generating a realignment of central parities. Finally,

according to the Svensson's measure, the loss of credibility in the final period would originate somewhat around June 13, when the return hovers around the upper bound and breaks it around June 21 with a sudden downward shift in the bands following on July 1st (when German rates are cut).

3.3 Measuring Credibility according to the AGS Model

To apply the AGS model to measure the level of Relative Credibility over the relevant period we start by assuming the level of absolute credibility corresponding to the announced $\pm 2.25\%$ band which in turn implies a weight of $w_a = 0.78$ in the convex combination between the institutional commitment and the free floating regime. As there were no realignments for the French Franc until the crisis of the end of July 1993, we keep this announcement as fixed in our analysis.

In order to extract the measure of relative credibility for the historical exchange rate, we face the problem of only having available the series of observed daily deviations from the central parity. Recall that relative credibility is a function of the difference between observed exchange rate and the exchange rate that would be observed if the policy maker completely adhered to the implications of the announcement. Under a flexible set of actions followed by the monetary authorities, the observed exchange rate would correspond to the outcome in the AGS model of the policy maker's optimization process and of the interaction between the policy maker and the markets. The "fundamentals" that gave rise to the observed exchange rate series are however not observed and now need to be estimated to get an operational measure of relative credibility. Once this estimated series is available we are in the position of deriving the exchange rate which would be perfectly consistent with the announcement, and hence of deriving the estimate of the relative credibility for the period under examination.

The chosen estimation strategy is by simulation in which, for a given set of parameters for the underlying fundamentals process, we can simulate paths of daily deviations from the central parity starting from the historical value on Oct. 30, 1991 where according to the AGS model at each period a new band width is implicitly chosen by the policy maker through his actions and the market expectations are updated.

We then retain, from a large set of generated paths only those that show the need for a new announcement on or about Aug. 2, 1993 (a leeway of 7 business days prior or posterior to that date is allowed), because the cumulated

political cost has passed the threshold which triggers such an announcement. For each replicated path we started at full relative credibility and at zero cumulated political cost. The estimator of the unobserved series is that which minimizes

$$\sum_{t=1}^{T} (s_t - g_w(k_t))^2 \tag{6}$$

i.e. the mean square error between the historical series and the simulated exchange rate as the outcome of the optimization process. From the optimal path we are able to invert the mapping onto the fundamentals $\hat{k}_t$ to estimate the implied fundamantals and hence retrieve the estimate for the exchange rate that would be consistent with the announced path $s_a(\hat{k}_t)$. The outcome is shown in Figure 4 where the historical and the announcement–consistent deviations from central parity are superimposed on each other. There are no extended periods of coincidence between the two paths, with days when the difference is positive (signalling that flexibility is exploited and political cost incurred) leading to a loss in relative credibility and periods of virtuous behavior characterized by a negative difference and a gain in relative credibility.

For the estimated path, the relative credibility function can be computed for each day and is shown in Figure 5: we can observe various periods when it exceeds unity. In particular, we can see a big loss in relative credibility corresponding to the September 1992 crisis which is rapidly neutralised. The switching between gains and losses of credibility, mentioned above, at the end of 1992 and up to the spring of 1993 (which is in line with the press reports) and a raise in credibility from April '93 to the end of May or beginning of June is also consistent with the press evidence.

According to our estimates, then, one would notice a rapid loss in credibility in mid-June which corresponds to the French decision to lower the key intervention rate below the corresponding German rate, an episode which is detected also by Svensson's measure. The novelty is that relative credibility lingers (contrary to prior episodes) around low levels and corresponds to the accumulation of political cost. The widening of the band is triggered in our estimation by the political cost passing over the threshold as shown in the Figure 6.[4] When one looks at this last figure one realizes that the estimated cumulated

[4]In fact the cumulated political cost is shown as the ratio to the threshold and is thus set between the values (-1,1). When the value of 1 is reached then an enlargement of the band is required and a tightening is possible when the value of -1 is reached. Recall that the level at which the new band limits are established is determined by the market perceived level of absolute credibility.

political cost had been steadily growing since the beginning of March, and that the policy actions of April and May (cabinet formation, budget and reform plan for the BdF) had just temporarily held back that tendency. The level of perceived credibility at the point of crisis is estimated as $\hat{w} = 0.24$ and corresponds to a band width of $\pm 7.9\%$ which would have been the optimal level suggested by our analysis as an expectation–compatible enlargement of the band (see Figure 2 to observe the behaviour of the exchange rate after the crisis). The institutionally chosen $\pm 15\%$ band corresponds in our calculations to $w = 0.06$, giving rise to a solution which thus places almost all weight on the free–float regime.

The results of the estimation process seem to be quite reassuring in that they show that optimizing behavior in which flexibility is explicitly taken into account as in the AGS model appears to be consistent with the historical evidence for the French Franc in the period leading up to the 1993 crisis in which the band–widths in the ERM were widened as predicted by the flexible target zone model. Previous crises are shown (cf. Figure 6) to have come close to the trigger point that would force a realignment but the cumulative political costs fell back (several times sizeably) corresponding to a recovery of relative credibility in the initial band–width announcement.

4 Conclusion

It would seem that the operation and structure of the ERM was eventually, if not initially, determined by motives other than simply stabilising currency fluctuations. The additional desire to impose convergence on the participating economies prior to European Monetary Union set a constraint on the system that it was eventually unable to bear and it was quite simply *not designed* to achieve these objectives. The policy coordination role explicitly recognised within the Maastricht Treaty appears to have taken a secondary role and the burden for achieving coordination and convergence was laid on the ERM. We have not considered in this paper how the equilibrium or central parity should be set which we see as being ultimately determined by these higher order issues relating to the international coordination of economic policy. Nevertheless we do feel that our analysis provides a clear explanation for the collapse of the ERM through its open loop commitment and suggests how it might be reformed by a more flexible *optimally* managed system within which policy coordination may be explicitly developed to achieve economic convergence should that be what is desired. It would seem inappropriate to attempt to achieve such an objective

through an exchange rate target zone alone whether it be flexible or rigid.

The critical element of the AGS model lies in the incorporation of relative credibility into the policy formulation process of the monetary authorities. The nature of the commitment made by the policy maker then reflects both his clear intention to continuously maintain the exchange rate inside the announced band but also the reality of the need to respond to temporary shocks that may entail greater flexibility than originally permitted by the announced target zone. Pressure created by non-convergence in the fundamentals must be resolved by coordination and the appropriate adjustment of the central parity. The *flexible* target zone proposal can then be seen as the implementation of a reputation sustained feedback strategy rather than the open loop precommitment found in the ERM and Bretton Woods. Alternatively it represents a half way house between complete discretion or leaning against the wind, as discussed by Svensson [1992], and open loop strategies that are periodically forced through crises such as those that hit the ERM over 1992/3.

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FIGURE2

FIGURE3

FIGURE4

FIGURE5.

FIGURE6.

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